WHAT IS CLAIMED IS:

1. A cholesteric liquid crystal cell unit receiving incident light, said unit comprising

a first cholesteric liquid crystal cell receiving said incident light, said first cholesteric liquid crystal cell reflecting circularly polarized light of one state of said incident light or transmitting said incident light responsive to a control signal; and

a second cholesteric liquid crystal cell arranged with respect to said first cholesteric liquid crystal cell to receive light transmitted by said first cholesteric liquid crystal cell, said second cholesteric liquid crystal cell selected to reflect or transmit light from said first cholesteric liquid crystal cell responsive to said control signal when said first cholesteric liquid crystal cell reflects said circularly polarized light of said one state or transmits said incident light respectively.

2. The cholesteric liquid crystal cell unit of claim 1 further comprising a π-phase waveplate element between said first and second cholesteric liquid crystal cells.

3. The cholesteric liquid crystal cell unit of claim 2 wherein said π-phase waveplate element comprises a third liquid crystal cell.

4. The cholesteric liquid crystal cell unit of claim 2 wherein said π-phase waveplate element comprises a plate of birefringent crystal material.

5. The cholesteric liquid crystal cell unit of claim 1 wherein said first cholesteric liquid crystal cell comprises a first cholesteric liquid crystal reflecting circularly polarized light in said one state, and said second cholesteric liquid crystal cell comprises a second cholesteric liquid crystal reflecting circularly polarized light in an opposite state.

6. An optical switch/attenuator device comprising

a first sleeve having a central longitudinal channel and an end face;

first and second optical fibers fixed in said first sleeve channel, said first and second optical fibers each having end surfaces coincident with said first sleeve end face;

a first collimating GRIN lens having first and second end faces, said first end face proximate said first sleeve end face;

a second sleeve having a central longitudinal channel and an end face;

a third optical fiber fixed in said second sleeve channel, said third optical fiber having an end surface coincident with said second sleeve end face;

a second collimating GRIN lens having first and second end faces, said first end face proximate said second sleeve end face, said second end face directed toward said second face of said first GRIN lens;

a cholesteric liquid crystal cell unit between said second end faces of said first and second GRIN lenses, said cholesteric liquid crystal cell unit having

a first cholesteric liquid crystal cell receiving incident light from said first GRIN lens, said first cholesteric liquid crystal cell reflecting circularly polarized light of one state of said incident light or transmitting said incident light responsive to a control signal; and

a second cholesteric liquid crystal cell arranged with respect to said first cholesteric liquid crystal cell to receive light transmitted by said first cholesteric liquid crystal cell, said second cholesteric liquid crystal cell selected to reflect or transmit light from said first cholesteric liquid crystal cell responsive to said control signal when said first cholesteric liquid crystal cell reflects said circularly polarized light of said one state or transmits said incident light respectively;

said first and second sleeves, said first and second GRIN lenses, said cholesteric liquid crystal cell unit arranged and oriented with respect to each other so that light from said first optical fiber passes through, and back from, said first collimating GRIN lens, and said cholesteric liquid crystal cell unit into said second optical fiber when said cholesteric liquid crystal cell units reflects light responsive to said control signal, and light from said first optical fiber passes through said first collimating GRIN lens, said cholesteric liquid crystal cell unit, and said second collimating GRIN lens into said third optical fiber when said cholesteric liquid crystal cell units transmits light responsive to said control signal.

7. The optical switch/attenuator device of claim 6 further comprising a π-phase waveplate element between said first and second cholesteric liquid crystal cells.

8. The optical switch/attenuator device of claim 7 wherein said π-phase waveplate element comprises a third liquid crystal cell.

9. The optical switch/attenuator device of claim 7 wherein said π-phase waveplate element comprises a plate of birefringent crystal material.

10. The optical switch/attenuator device 6 wherein said first cholesteric liquid crystal cell comprises a first cholesteric liquid crystal reflecting circularly polarized light in said one state, and said second cholesteric liquid crystal cell comprises a second cholesteric liquid crystal reflecting circularly polarized light in an opposite state.

11. The optical switch/attenuator device of claim 6 further comprising

a fourth optical fiber fixed in said second sleeve channel, said fourth optical fiber having an end surface coincident with said second sleeve end face; and

wherein said first and second sleeves, said first and second GRIN lenses, said cholesteric liquid crystal cell unit arranged and oriented with respect to each other so that light from said fourth optical fiber passes through, and back from, said second collimating GRIN lens, and said cholesteric liquid crystal cell unit into said third optical fiber when said cholesteric

liquid crystal cell units reflects light responsive to said control signal, and light from said fourth optical fiber passes through said second collimating GRIN lens, said cholesteric liquid crystal cell unit, and said first collimating GRIN lens into said second optical fiber when said cholesteric liquid crystal cell units transmits light responsive to said control signal.

12. The optical switch/attenuator device of claim 6 wherein said cholesteric liquid crystal cell unit reflects light responsive to a first control signal voltage and transmits light responsive to a second control signal voltage and proportionally transmits and reflects light responsive to control signal voltages intermediate said first and second control signal voltages.

13. A WDM add/drop multiplexer comprising

a first sleeve having a central longitudinal channel and an end face;

a network input optical fiber;

a network output optical fiber, said network input and output optical fibers fixed in said first sleeve channel and having end surfaces coincident with said first sleeve end face;

a first collimating GRIN lens having first and second end faces, said first end face proximate said first sleeve end face;

a second sleeve having a central longitudinal channel and an end face;

an add optical fiber;

a drop optical fiber, said add and drop optical fibers fixed in said second sleeve channel and having end surfaces coincident with said second sleeve end face;

a second collimating GRIN lens having first and second end faces, said first end face proximate said second sleeve end face, said second end face directed toward said second face of said first GRIN lens;

a wavelength-dependent filter proximate said second end face of said first collimating GRIN lens, said wavelength-dependent filter transmitting light at selected wavelengths and reflecting light at other wavelengths;

a cholesteric liquid crystal cell unit between said wavelength-dependent filter and said second end face of said second GRIN lenses, said cholesteric liquid crystal cell unit having

a first cholesteric liquid crystal cell receiving incident light from said first GRIN lens, said first cholesteric liquid crystal cell reflecting circularly polarized light of one state of said incident light or transmitting said incident light responsive to a control signal; and

a second cholesteric liquid crystal cell arranged with respect to said first cholesteric liquid crystal cell to receive light transmitted by said first cholesteric liquid crystal cell, said second cholesteric liquid crystal cell selected to reflect or transmit light from said first cholesteric liquid crystal cell responsive to said control signal when said first cholesteric liquid crystal cell reflects said circularly polarized light of said one state or transmits said incident light respectively;

said first and second sleeves, said first and second GRIN lenses, wavelength-dependent filter, and said cholesteric liquid crystal cell unit arranged and oriented with respect to each other so that light from said network input optical fiber at said other wavelengths passes through, and back from, said first collimating GRIN lens and said wavelength-dependent filter into said network output optical fiber, and so that that light from said network input optical fiber

at said selected wavelengths passes through, and back from, said first collimating GRIN lens, said wavelength-dependent filter, and said cholesteric liquid crystal cell unit into said network output optical fiber when said cholesteric liquid crystal cell units reflects light responsive to said control signal, and so that light from said first optical fiber at said selected wavelengths passes through said first collimating GRIN lens, said cholesteric liquid crystal cell unit, and said second collimating GRIN lens into said drop optical fiber when said cholesteric liquid crystal cell units transmits light responsive to said control signal, and so that light from said add optical fiber at said selected wavelengths passes through said second collimating GRIN lens, said cholesteric liquid crystal cell unit, said wavelength-dependent filter and said second collimating GRIN lens into said network output optical fiber when said cholesteric liquid crystal cell units transmits light responsive to said control signal.

14. The WDM add/drop multiplexer device of claim 13 further comprising a optical fiber loop having first and second end sections arranged and oriented in said first sleeve channel so that light from said network input optical fiber at said other wavelengths passes through, and back from, said first collimating GRIN lens and said wavelength-dependent filter into said first end section and passes from said second end section through, and back from, said first collimating GRIN lens and said wavelength-dependent filter into said network output optical fiber.

15. The WDM add/drop multiplexer device of claim 13 further comprising a π-phase waveplate element between said first and second cholesteric liquid crystal cells.

16. The WDM add/drop multiplexer device of claim 15 wherein said π-phase waveplate element comprises a third liquid crystal cell.

17. The WDM add/drop multiplexer device of claim 15 wherein said π-phase waveplate element comprises a plate of birefringent crystal material.

18. The WDM add/drop multiplexer device of claim 13 wherein said first cholesteric liquid crystal cell comprises a first cholesteric liquid crystal reflecting circularly polarized light in said one state, and said second cholesteric liquid crystal cell comprises a second cholesteric liquid crystal reflecting circularly polarized light in an opposite state.

19. An optical switch system comprising

an array of input optical fibers;

an array of first output optical fibers; and

a switching matrix of cholesteric liquid crystal cell units, each liquid crystal cell unit reflecting or transmitting light selectively responsive to control signals and arranged with respect to said array of input optical fibers and said array of first output optical fibers so that light signals from an input optical fiber may be selectively reflected or transmitted by said liquid crystal cell unit into one of said first output optical fibers.

20. The optical switch system of claim 19 wherein said array of input optical fibers and said array of first output optical fibers comprise two-dimensional arrays, and said switching matrix of cholesteric liquid crystal cell units comprises a three-dimensional array.

21. The optical switch system of claim 19 further comprising an array of second output optical fibers, said array of second output optical fibers arranged with respect to said array of input optical fibers, said array of first output optical fibers and said switching matrix of cholesteric liquid crystal cell units so that light signals from an input optical fiber may be selectively transmitted or reflected by an liquid crystal cell unit into one of said second output optical fibers.

22. The optical switch system of claim 21 wherein said array of input optical fibers, said array of first output optical fibers and said array of second output optical fibers comprise two-dimensional arrays, and said switching matrix of cholesteric liquid crystal cell units comprises a three-dimensional array.

23. The optical switch system of claim 19 wherein each cholesteric liquid crystal cell unit comprises

a first cholesteric liquid crystal cell arranged to receive incident light from an input optical fiber, said first cholesteric liquid crystal cell selectively reflecting circularly

polarized light of one state of said incident light or transmitting said incident light responsive to a control signal; and

a second cholesteric liquid crystal cell arranged with respect to said first cholesteric liquid crystal cell to receive light transmitted by said first cholesteric liquid crystal cell, said second cholesteric liquid crystal cell selected to reflect or transmit light from said first cholesteric liquid crystal cell responsive to said control signal when said first cholesteric liquid crystal cell reflects said circularly polarized light of said one state or transmits said incident light respectively.

24. The optical switch system of claim 23 further comprising a π-phase waveplate element between said first and second cholesteric liquid crystal cells.

25. The optical switch system of claim 24 wherein said π-phase waveplate element comprises a third liquid crystal cell.

26. The optical switch system of claim 24 wherein said π-phase waveplate element comprises a plate of birefringent crystal.

27. The optical switch system of claim 23 wherein said first cholesteric liquid crystal cell comprises a first cholesteric liquid crystal reflecting circularly polarized light in said

one state, and said second cholesteric liquid crystal cell comprises a second cholesteric liquid crystal reflecting circularly polarized light in an opposite state.

28. The optical switch system of claim 20 wherein said switching matrix of cholesteric liquid crystal cell units comprises a plurality of cholesteric liquid crystal cell unit mounting plates, each cholesteric liquid crystal cell unit mounting plate having at least a one-dimensional array of said cholesteric liquid crystal cell units and arranged at an angle with respect to said array of input optical fibers and said array of first output optical fibers.

29. The optical switch system of claim 28 wherein at least one of said cholesteric liquid crystal cell mounting plates has a two-dimensional array of said cholesteric liquid crystal cell units.

30. The optical switch system of claim 29 wherein said switching matrix comprises a plurality of separation plates, each separation plate separating two cholesteric liquid crystal cell unit mounting plates.

31. The optical switch system of claim 30 wherein said switching matrix comprises said cholesteric liquid crystal cell units arranged in a cube.

32. The optical switch system of claim 20 wherein each array of input optical fibers and first output optical fibers comprises a plurality of collimating GRIN lenses, each GRIN lens proximate ends of said input optical fibers and first output optical fibers.

33. The optical switch system of claim 20 wherein each array of input optical fibers and first output optical fibers comprises a plurality of collimating microlenses, each microlens proximate ends of said input optical fibers and first output optical fibers.

34. The optical switch system of claim 20 wherein each array of input optical fibers and first output optical fibers comprises

a first plate having a surface with a plurality of V-grooves therein; and

a second plate having a surface with a plurality of V-grooves therein, said second plate V-grooves matching said first plate V-grooves;

said first and second plates fixed together so that said V-grooves form channels holding a linear array of optical fibers.

35. The optical switch system of claim 34 further comprising a plurality of said first and second plates fixed together and arranged in a stack to form a two-dimensional array of optical fibers.

36. The optical switch system of claim 22 wherein said switching matrix of cholesteric liquid crystal cell units comprises a plurality of cholesteric liquid crystal cell unit mounting plates, each cholesteric liquid crystal cell unit mounting plate having at least a one-dimensional array of said cholesteric liquid crystal cell units and arranged at an angle with respect to said array of input optical fibers, said array of first output optical fibers and said array of second output optical fibers.

37. The optical switch system of claim 36 wherein at least one of said cholesteric liquid crystal cell mounting plates has a two-dimensional array of said cholesteric liquid crystal cell units.

38. The optical switch system of claim 37 wherein said switching matrix comprises a plurality of separation plates, each separation plate separating two cholesteric liquid crystal cell unit mounting plates.

39. The optical switch system of claim 38 wherein said switching matrix comprises said cholesteric liquid crystal cell units arranged in a cube.

40. The optical switch system of claim 22 wherein each array of input optical fibers, first output optical fibers and second output optical fibers comprises a plurality of

collimating GRIN lenses, each GRIN lens proximate ends of said input optical fibers, first output optical fibers and second output optical fibers.

41. The optical switch system of claim 22 wherein each array of input optical fibers, first output optical fibers and second output optical fibers comprises a plurality of collimating microlenses, each microlens proximate ends of said input optical fibers, first output optical fibers and second output optical fibers.

42. The optical switch system of claim 22 wherein each array of input optical fibers, first output optical fibers and second output optical fibers comprises

a first plate having a surface with a plurality of V-grooves therein; and

a second plate having a surface with a plurality of V-grooves therein, said second plate V-grooves matching said first plate V-grooves;

said first and second plates fixed together so that said V-grooves form channels holding a linear array of optical fibers.

43. The optical switch system of claim 42 further comprising a plurality of said first and second plates fixed together and arranged in a stack to form a two-dimensional array of optical fibers.